Assessing Global Change Impact on the US using National Lightning Data

Project Status

National Climate Assessment

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(abbreviated version)

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Project Focus

Assessment Tool

- LSAT software for analyzing NLDN data

Accomplishments

- **Developed a Lightning Software Analysis Tool (LSAT)**
  - written in IDL programming language
  - ingests, calculates, and visualizes national CG lightning data
  - now serves as a new "sustaining assessment" tool

- **Applied LSAT to analyze CG lightning over a region slightly larger than CONUS during the period 2003-2011.**

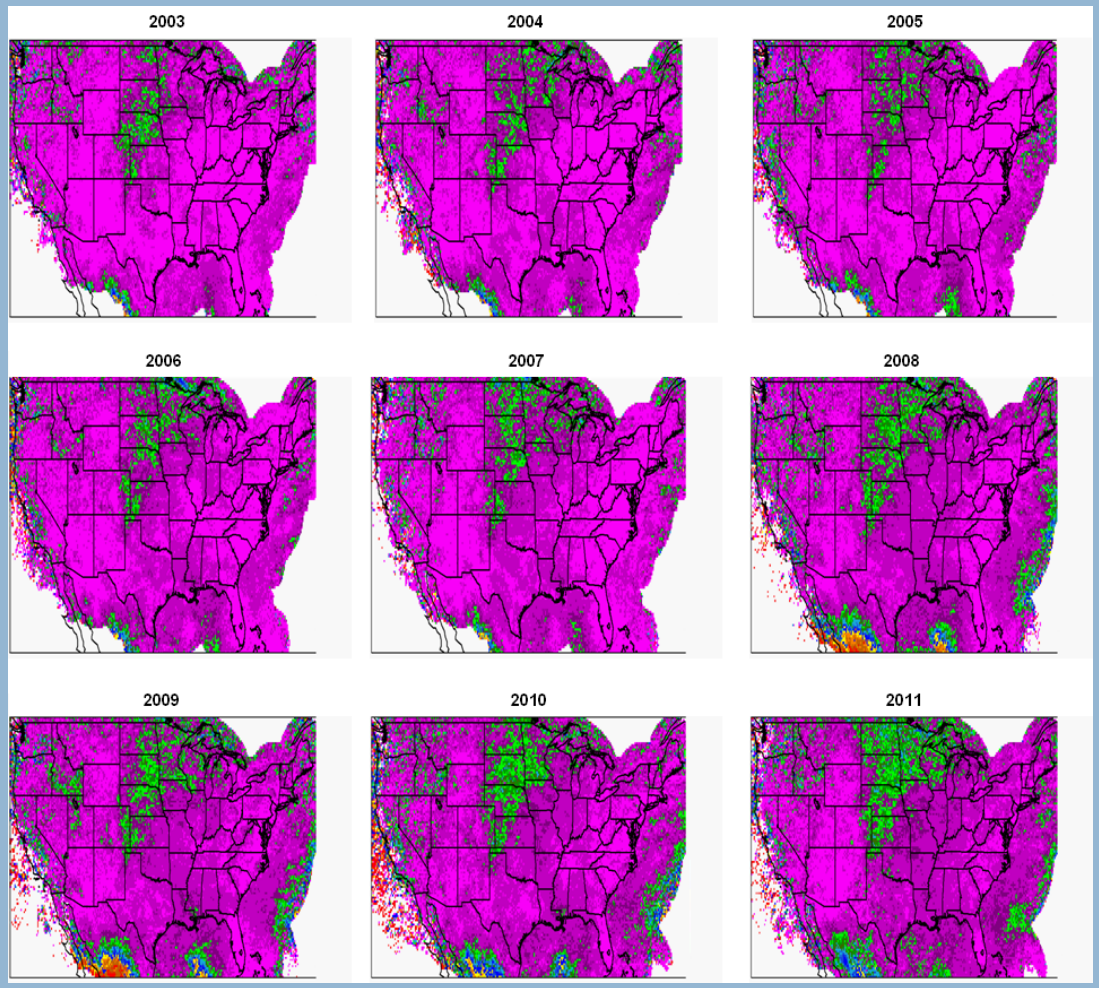
- **Used NOAA *Storm Data*, and National Interagency Fire Center (NIFC) data to obtain lightning-caused death/injury, crop damage, wildfire stats.**

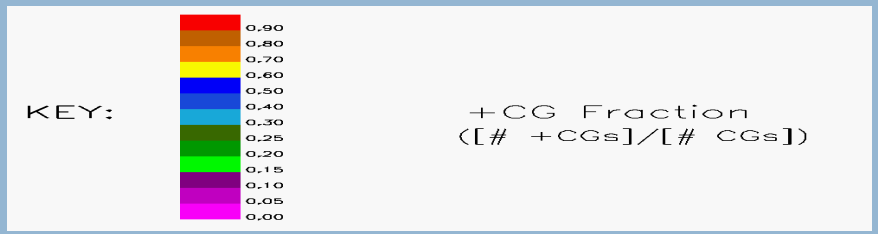
- **Compared average values (2003-2006) with average values (2007-2010):**
  - ✓ CG lightning frequency dropped by 10.7%
  - ✓ Fatalities dropped by 13.5%
  - ✓ Injuries dropped by 31.2%
  - ✓ Crop damage dropped by 61.25%
  - ✓ # wildfires dropped by 23.6%
  - ✓ Wildfire burn acreage dropped by 8.3%
  - ✓ Multiplicity dropped by 2.4%
  - ✓ *Peak current increased by 9.9%*

- ***Number of +CG (and +CG fraction) monotonically trended upward in 2003-2011***

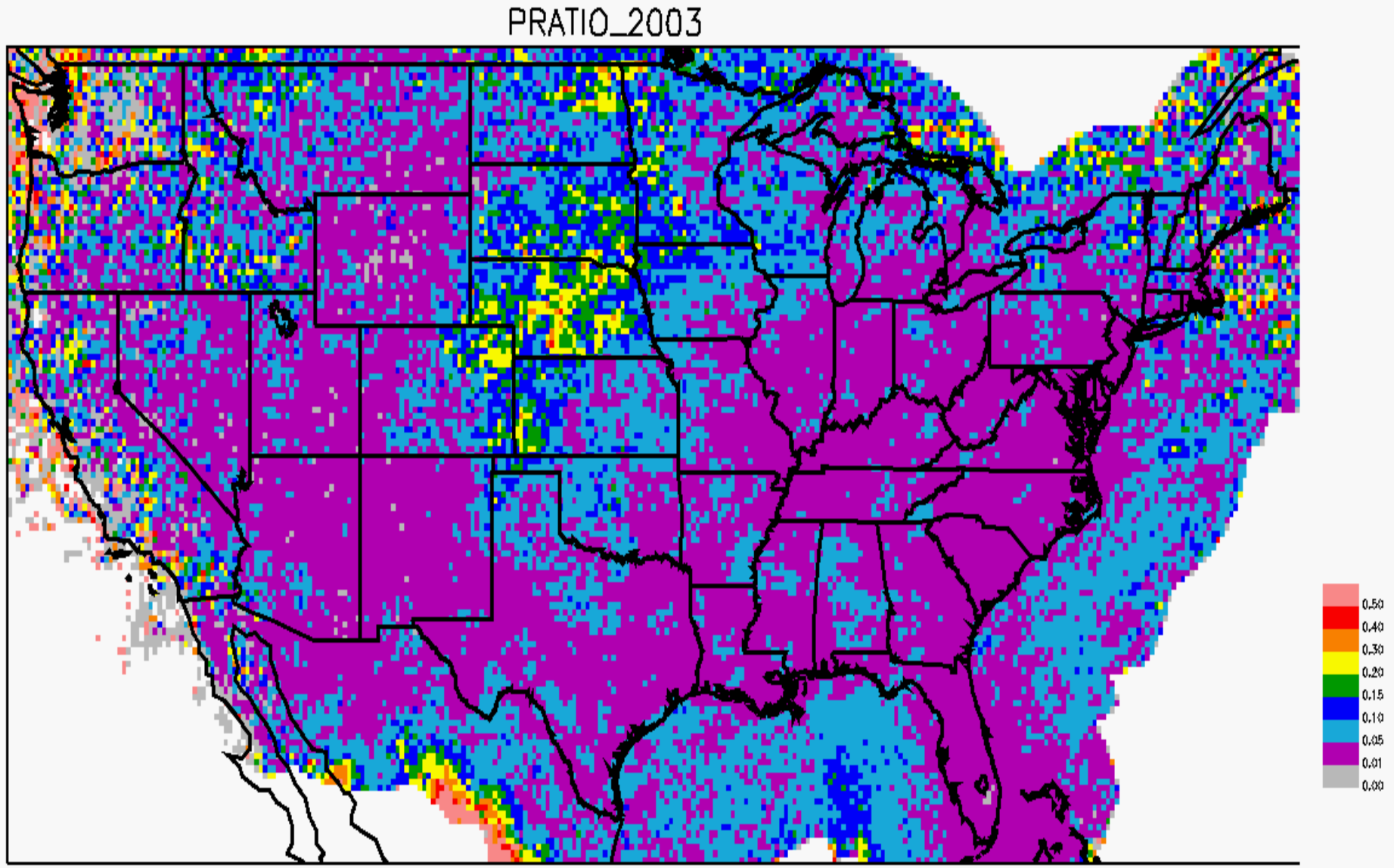
Positive CG Fraction Trends Up
(linked to Severe Wx)

Sample LSAT output





POSITIVE CG FRACTION



Accomplishments (cont.)

- **Examined effects of National Lightning Detection Network Upgrades**
  - 2002-2003 Upgrade (all sensors replaced w/new IMPACT-ESPs + 8 sensors added)
  - 2004 Propagation Model Upgrade (increases peak current values)
  - 2006 Sensor Addition Upgrade (2 sensors added SE of Florida)
  - 2006 E-Field Waveform Detection Criteria Upgrade (short PTZ waveforms admitted to allow limited IC detection; increases CG count but some are cloud flashes)
  - 2006 15kA Rule Upgrade (no effect since already accounted for)
  - 2008 Location Algorithm Upgrade (extend range to offshore & N. Mexico)
  - 2008 Duplicate/Misplaced Events Upgrade (improvements in removing these)
- **Only important effect seems to be a network change in 2008 that abruptly increased +CG fraction. Still investigating.**

Accomplishments (cont.)

- ❑ **Completed conservative risk-based assessment**

$$\left(\frac{\Delta \text{Impact}}{\Delta \text{Lightning}}\right)\left(\frac{\Delta \text{Lightning}}{^{o}C}\right)=\left(\frac{\Delta \text{Impact}}{^{o}C}\right)$$

From LSAT | From Literature* | Result

Human Health:
- Fatalities: 13.98 deaths per 1°C
- Injuries: 87.47 injuries per 1°C

Agriculture:
- Crop Damage: $49,348 per 1°C

Forestry:
- Wildland Fires (Number): 4091.0 wildfires per 1°C
- Wildland Fires (Acres): 936,097.6 acres per 1°C

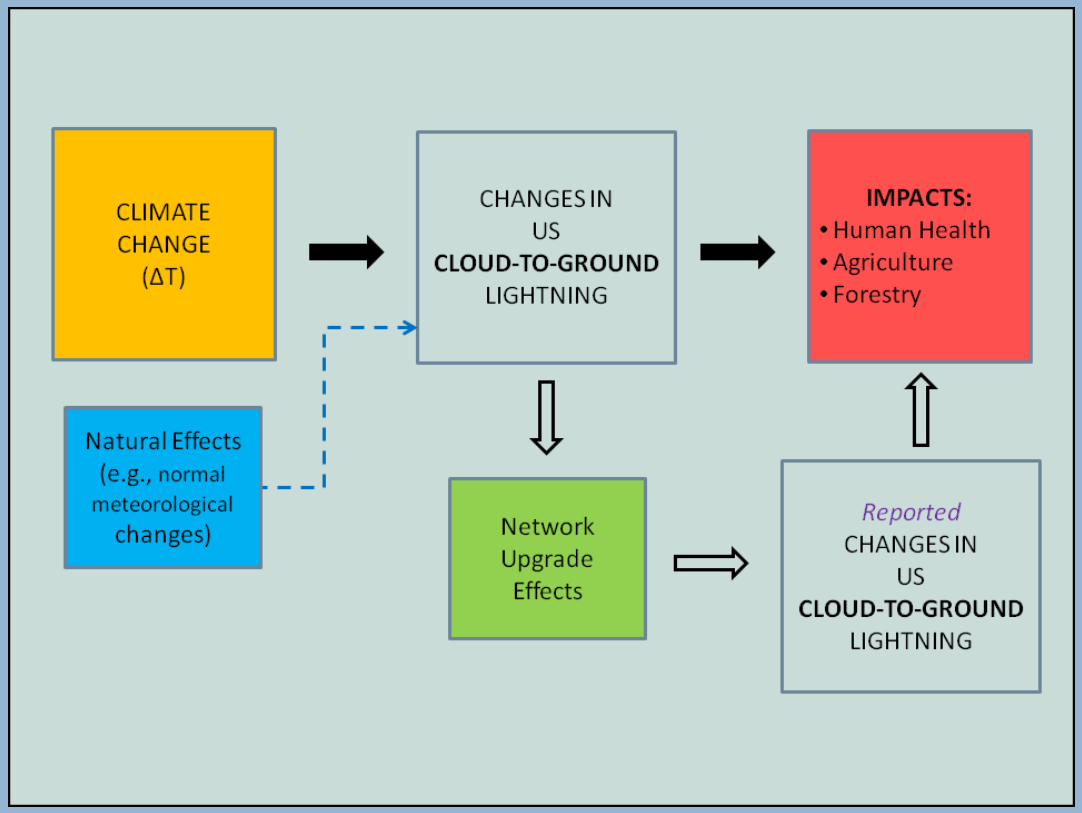
- ❑ **Completed a 32 page Technical Input Report (TIR) to summarize findings.**
- ❑ **Submitted TIR on February 22, 2012. Peer-Reviewed & Revised by May 3.**

*Reeve & Toumi (1999): 40±14% change in CG frequency per 1°C; and Price & Rind (1994) found that CG frequency more sensitive to temperature changes than cloud flash frequency.

Plans for Future

- Apply LSAT to complete 2012 analyses.

- Convert TIR into journal article for publication
  - Add 2012 results
  - Continue Examining Effects of Network Upgrades on Lightning
  - Examine Natural Effects on Lightning (other than Climate Change):



Plans for Future (cont.)

- **Thru ROSES A.47 Call, develop & track <u>additional indicators</u>:**
  - **TRMM/LIS data to examine lightning NOx in Southern CONUS:**
    - **Total (CG + cloud flash) lightning**
    - **Flash optical area**
    - **Flash optical radiance**

    } Increases in these increase NOx & therefore influence Ozone and OH radical concentrations (hence climate).

  - **Collaborate with City College of New York & NOAA/CREST to develop & track <u>additional indicators</u> that use CONUS radar data:**
    - **(Lightning/Rain) Ratio:** Important for "dry lightning" (Wildfires)
    - **(Lightning x Rain) Product:** Characterize freq of intense convective events (related to Extreme Wx).